

A Review of Joint Management Body and Life Cycle Cost Analysis for Green Building Project Facilities Management

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In Dubai, Green complex buildings, either with smart green buildings or conventional design, still face defiance associated with facility management, maintenance, and property management. Much research confirms unpredictability measures of the financial obligation and maintenance budget allocated for operating sustainable buildings. As a result, it creates a critical gap when the project is handover to the facility management without the proper future cost incurred between the end-users and project management. This paper introduces the proposed research aim to initiate a new life cycle plan model and guideline for JMB involvement in sustainable building development. Moreover, it exhibits an intensive review of the needs of the Joint Management Body depicted with the life cycle cost analysis, which forecasts the cost of facilities management. It is also emphasized the figure out the variables related to the JMB_LCC model. A combination methodology of the quantitative survey using the Likert method qualitative survey is planned to carry the LCC-JMB model, and mathematical modeling of the LCC calculator will be implemented. The outcome of this study is a pathway for future research to integrate other parameters that influence the life cycle cost analysis for the green building, which creates a novelty on significant roles of JMB.

1. Introduction

Urbanization has a critical influence on the earth, the public, and health. Buildings consume resources, produce waste, and are costly to preserve or operate. In 2017, the United Arab Emirates (UAE) adopted Sustainable Development Goals (SDGs) and implemented SDGs into strategies in development projects and operation actions at both local and federal orientation. Then, it inaugurated local development priorities and agenda 2030. As a result, the orientation toward responsiveness to sustainability has increased. Dubai statistics center report (2021) showed a growth rate of buildings increased by 7.15 % in 2019. Dubai accounts for 81 % of the world's new green building development projects (Abdul Hay, 2020). In contrast, green building principles face challenges in different fields such as technology, marketing, authorities and regulations, and engineering management. The sustainable building codes create a radical change in construction management which is a comprehensive evaluation of designing, constructing, and operating buildings to maximize occupant productivity, consume resources at an optimal level, and decrease life cycle costs. The sustainable green complex building consists of several stakeholders such as the owner, end-user, facility management, and Joint Management Body (JMB). With different potentials and interests, the developer will control the life cycle cost analysis during the project's beginning phase and the JMB during the operation and maintenance phase.

United Arab Emirates (UAE) cabinet approved the adoption of green building standards and sustainable construction standards across the country. These standards were introduced in government buildings in early 2011. This movement is expected to target savings of 10 B Dirhams by 2030 and reduce about 30 % of CO₂ emissions as reported by the official gateway to the UAE government (2020). In 2018, Dubai launched a green building stander code to control Environmental and resource challenges (Alhamlawi et al., 2021). The SAVAT covers 79 standard specifications. This action motivates the construction field toward green building rapidly. As

a result of that, UAE ranks 14th worldwide for the number of sustainable buildings according to the second edition of (Y) our Space report released by Knight Frank (Elliott, 2021) and the third among the world's cities with the most significant number of certified LEED green buildings with a growth of 10 % in the asset values of sustainable buildings (Mohammed, 2020). Researchers found that sustainable building costs 28 % more than traditional building.

The research figured out that the life cycle cost of green building reaches up to 28 % less than conventional (Weerasinghe et al., 2017). Comparatively, green buildings reduced the allocated budget for operation and maintenance costs. Despite all that, owners and investors have called for several real estate projects in Abu Dhabi to decrease the service fees paid to developers of property facility management, stressing the essential of regulatory mechanisms to evaluate fee charges. Dubai Land Department stated that more than 50 % of property unit service fees go to the cooling system, 5.5 % for maintenance, and around 20 % for waste management (Haidar, 2019). The main challenges of green building are the service, operation, and maintenance charges which consider high and account for 20 % of the investment return in leasing the premises unit (Al-Sweifi, 2018). These challenges indicated a critical gap in the handover stage where the developer handles the operation responsibility to the JMB or facility management agency. JMB has not engaged the sustainable building complex planning and design at the beginning phase of a Green Building Project. It is significance required to integrate a new model and approach that forecasts the optimal cost solution and incorporates the JMB at the planning and design stage. In the conceptual design phase of sustainability, there is an advanced degree of change in the technology selection, process development, or adoption of the sustainability perspective to achieve low marginal costs (Tacchini et al., 2022). Thereby, Life Cycle Costing (LCC) can be made to forecast finances for facility management. This innovative planning model for the life cycle estimates the cost of engaging the JMB at the inception stage to achieve reasonable service fees to maintain the smart and sustainable features and facilities of the green building. The JMB-LCC model is targeted to provide a better solution toward a better green building decision making attract the stakeholders by allowing them to determine the initial and future cost and the associated operation fees of green building knowledge with novelty.

Life Cycle Cost Analysis has not been involved in a joint management body at the initiation stage of a Green Building Project, epically in the planning phase, as illustrated in Figure 1. Therefore, it creates a gap in conventional management procedures that additional conditions and terms can evolve from modeling a holistic approach to managing the sustainable building. This limitation identified a research gap. Therefore, developing, editing, re-establishing project management procedures, and reshaping Joint Management Body duties is necessary, essential, and urgent. The new planning model will engage the JMB in the green building project's inception phase and address the LCCA to overcome the project management failure during the operation and maintenance phase.

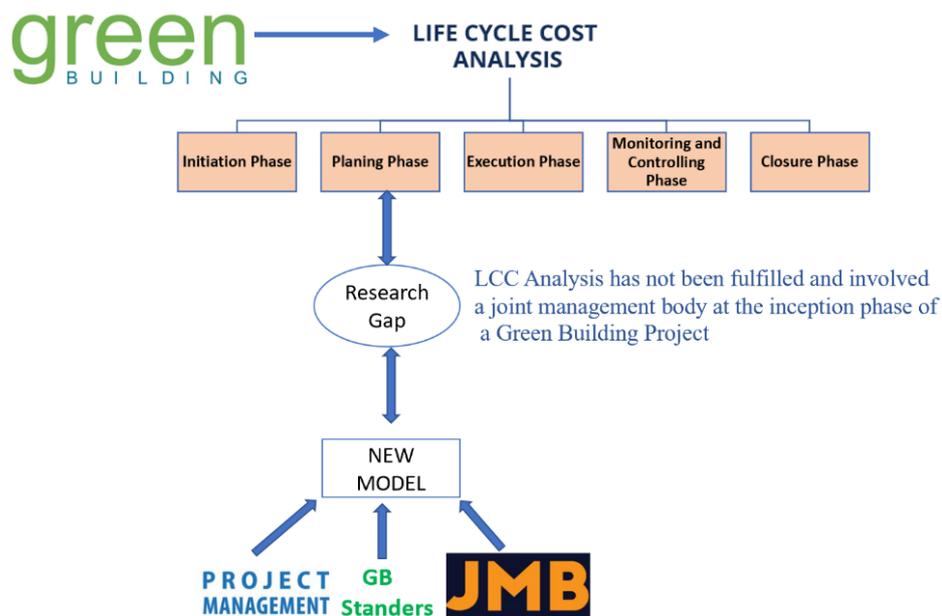


Figure 1: Research gap map

2. Literature review

2.1 Developing Life Cycle Cost Analysis in green building

Life Cycle Cost Analysis (LCCA) is a procedure for assessing the financial performance of a building over its whole life. LCCA equilibria preliminary monetary investment with the long-term outflow of constructing, maintaining, and operating the building (Hajare and Elwakil, 2020). The U.S. Department of Defense introduced LCC in the 1960s for procurement evaluation. In 1978, the American Institute of Architecture used LCC analysis in the design process of construction activities (Stec, 2019). In the sequence years, many attempts were made to implement this methodology in urban projects starting with infrastructure projects and then the whole construction phase. Currently, it is implemented in various fields of economy, especially in construction. The U.S. Green Building Council (USGBC) launched the Leadership in Energy and Environmental Design (LEED) rating program in 2000 (Moussa and Farag, 2017). LEED produced global green building rating systems and codes for the project stockholder to optimize the building's economy and manage resource efficiency. LEED established the Whole Building Life Cycle Assessment under certified Silver, Gold, and Platinum award levels. LEED only, addresses the LCC in the Life Cycle Assessment from some angles. The General Director for Entrepreneurship and Industry at the European Commission initiated the LCC methodology for sustainable and green building in 2006 (Agnieszka Stec, 2019) portrayed in Figure 2. The mutation in LCC occurred in 2008 when The International Organization for Standardization (ISO), which is a worldwide federation of national standards organization, established the LCC as a tool and instrument in the assessment of building development investment projects ISO 15686-5 in 2008 (Arya and Sharma, 2022). From that time to the present, researchers have exploited this instrument to create a novelty in integrations between LCC with other tools in green building projects to shrink the gaps in the Sustainable building LCC field and overcome the limitations.

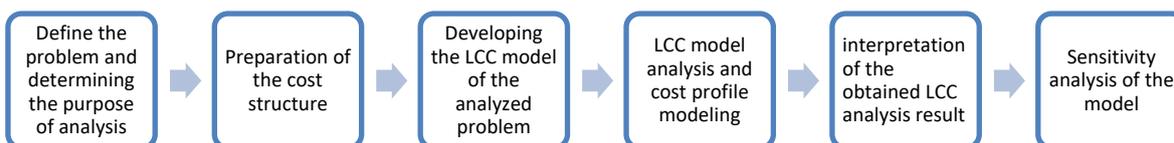


Figure 2: Stages of conducting LCCA (Agnieszka Stec, 2019)

Many standards measure the cost analysis, such as the Payback Period, Internal Rate of Return, and Net Savings. The most significant forthright clarification of the calculation of economic value is the lowermost LCC (Sieglinde Fuller, 2016). LCC can measure the investment's long-term financial worth by calculating the initial investment and discounted future costs (Wang, 2018). LCC distribute and derive cost associated with the analysis into main segments. Initial investment costs are the investment value where the building utilities and services are called an operation cost. The cost related to maintaining the building at its performance target is called maintenance. Some costs are relevant to the decision-making, such as repair and replacement costs. Finally, Residual Value presents salvage value and the remaining value of the asset (Yasinta et al., 2020).

2.2 Emergent Joint Management Body and Life Cycle Cost Analysis in Green Building

Green buildings are constantly being developed near public transportation to provide environmentally friendly public utilities (Breisinger et al., 2012). It provides facilities and amenities more stylish than traditional buildings. These features support the resident to optimally consume power and water resources, reducing operation and service fees. Another reason people prefer to construct a green building is the availability of modern, innovative, and intelligent green technology. Despite this, most sustainable complex buildings were not effectively managed. Sustainable building design or conventional challenges are linked with property management, risk management, and communication management. Another critical challenge is the lack of professionals in managing green building multidiscipline functions that require the integration of various stakeholders. Users complained about the incompetent facility management, such as vandalism, disputes among users, waste management, and mechanical, electrical, and plumbing failures (Khan et al., 2018).

Among the significant challenges of green building, developments are the maintenance and the financial liabilities. Stakeholders in the green building complex have different perspectives on cost objectives, outcomes expectations, and values. Joint Management Body is needed to monitor, control, and maintain the entire property facility management (Abas et al., 2021). The JMB committee manages the sustainable building operation and maintenance phases. JMB members represent the tenants, facility managers, developers, or users of the sustainable building. It is different in JMB terms internationally, but the responsibility is fixed. For example, in Malaysia, the Strata Management Act identifies a Joint Management Body (JMB) or Management Corporation (MC) as a formed board to control maintenance.

regulate the facility management for the common property in complex buildings. The Joint Management Body is an initiated of the Management Corporation formulated for self-management of the building and consists of tenants, developers, buyers, and facilities management agents (Khalid et al., 2017). In Dubai, property ownership is a body established under Law No. 27 of 2007 to maintain and manage buildings before the appointment of the Management Corporation. In Chapter 4, Article 17, the holder association is authorized to gain powers and execute duties. Various fundamental aspects in property maintenance make a conducive living environment for occupants and visitors. For example, technical, social facilities, and management fields are essential to conserving the property's net present value (Law No. (6) of 2019 Concerning Ownership of Jointly Owned Real Property in the Emirate of Dubai Page 1 of 29, 2019).

In general, the response behind JMB's failure in managing the building facilities is that the financial decision target the short-term performance with less consideration for future value. The green building shareholders tend to focus on the initial investment and power-saving cost throughout the LCC of property. While in contrast, JMB considers maintenance and operation costs. Optimizing the LCC is essential for the green complex decision-making that the design with the lowest value of LCC can be selected (Heralova, 2017). Property management requires precise planning from the inception phase to ensure efficient serviceability of the green building and to achieve the satisfaction of all shareholders by adopting an integrated JMB- LCC planning model which addresses the whole life-cycle of the high-rise building. This integrated practice significantly plays a role in resolving property management's arising issues.

Table 2: Integrated matrix of selective critical literature review analysis

No.	Criteria Development Impact	Facility Management	Green Building	Green Building Rating tools	LCCA	LCC integrated with Stander Tools	JMB	Reference
1.					√			O'Brien et al. (2020)
2.		√						Alfalah and Zayed (2020)
3.				√	√			Gopanagoni and Velpula (2020)
4.					√			Khan et al. (2018)
5.		√					√	Abas et al. (2018)
6.			√	√		√		Khan et al. (2019)
7.	√				√			Kambanou and Sakao (2020)

In this research, Selective Critical Literature Review Analysis (SCLRA), an integrated matrix of 40 critical literature reviews, The SCLRA analysis identifies various aspects of relationship figured within the prior study, including criteria development impact, Impact of Green building standard and tools, a factor of Facility Management failure, the relationship of LCCA and Green Building codes adding to that the vulnerability of Joint Management Body. SCLRA analysis figures out that there is significantly essential to establish a new planning model that integrates the Joint Management body and LCC in green buildings. The analysis found that there are three studies have identified the challenges associated with the JMB in managing the facility management in green buildings and found that there is no study of cost wise perspective that prevails the hiatus that there is a prospect to consolidate Joint Management Body with LCC. The Joint Management Body-Life Cycle Analysis model will address the costs associated with sustainable building and motivate to promote the interest of various stakeholders in green building.

3. Research lead for methodology

Despite all the knowledge database in life cycle cost analysis, green building integrated tools, and standards, there is still a lack of knowledge in the Joint Management Body or the Property management field. Therefore, the proposed study is developed by problem formulation through in-depth critical literature, content analysis, and Intensive Literature review of books, reports published, conference journal articles, and theses from international and national electronic database resources. For example, research gate, Web of science, emerald publishing and ScienceDirect platforms. After problem formulation, "How to improve facility management in the green building and reduce the service fees," must be resolved by a holistic method that initiates A Life Cycle Cost Planning Model of Joint Management Body Facilities Management in Green Building Project. The research is carried out at the beginning by identifying the research problem, determining the research gap, aim, objectives, and the scope of the research, followed by the novelty and significance of the research, as illustrated

in figure 2. In conformity to developing a new life cycle plan model guideline for JMB involvement in green building development via the forecast of LCC analysis, the objects were developed depending on the Cost component in ISO 15686-5 (ISO 15686-5, 2017). This study depends on a mixed research design, including quantitative and qualitative approaches. In qualitative methods, prime resources will be collected by conducting a questionnaire and personal interviews. Focused Group Discussion within qualified Professionals and Experts instrument will direct the project management board member and the managerial level in the facility management field. At the same time, the questionnaire will target the residents, users, and visitors of the sustainable complex building.

In addition, Focused Group Discussion (FGD) instrument within qualified professionals and experts in managing project facilities, landowner committees, and real estate developers such as EMMAR, MAG, NAKEEL, and DAMAC. FGD is a way to gather qualified professionals in green buildings to debate the JMB_LCC correlation. The FGD design is prepared from LCC and JMB regulations and tools. In the end, the factors and criteria for involving JMB in the planning stage of green buildings were validated and finalized by experts during the FGD. In the next phase, the data collected was analyzed using Microsoft Excel and Statistical Package for Social Science (SPSS) programs. Factor analysis and Weightage Factor have been conducted in this phase. The final stage confirmed the results to model a new life cycle planning of a green building project under a Joint Management Body with the LCC analysis forecast using the LCC Mathematical Modelling instrument and LCC Calculator development analysis via SEM.

4. Conclusion

Green building achieved an ambition designed for it through the development of the research and integration in sustainability which contributed to achieving environmental reserve and cost-saving for investors and developers. On the other hand, residents face higher operation or service fees due to the lack of specialization in managing green building facilities with the JMB. Significantly, there is a defect in the life cycle cost planning. This deficit result of the isolation of JMB from the LCCA process. This paper highlights a research proposal to develop a new life cycle plan model for JMB involvement in green building development via the forecast of LCC analysis. Using LCC analysis, the new guideline for forecasting the cost of JMB involvement at the planning stage inspires a new innovative approach to green building development. This Joint Management Body-Life Cycle Analysis model will provide an efficient and better platform for design by minimizing operation costs and selecting the best sustainable feature. Developing a guideline for the sustainable complex will contribute significantly to the utilization of life cycle cost analysis and future cost. Accordingly, green building investment can achieve the planned and targeted green building outcome. The obstacles of future costs are potentially minimized to the lower levels. The frequent failures of facility management, sustainable components, and features are addressed in the planning stage and monitored throughout the project life cycle. This model is significant to be adopted by a developer and governmental organizations for better green building development. At the same time, facility management achieves a cut price for annual operating and service fees.

References

- Abas D.N., Zakaria R., Aminuddin E., Abdullah R., Khan J.S., Sahamir S.R., 2018, An outlook on strategic framework development needs of roles and involvement of joint property management in high rise green buildings in Malaysia, *Chemical Engineering Transactions*, 63, 427–432.
- Abas D.N., Zakaria R., Aminudin E., Lah N.A.A., Sharin N.S.A. M.N., Sahamir S.R., 2021, Issues and challenges of joint management body in high-rise residential facilities management: The developers, *Civil Engineering and Architecture*, 9(5), 33–40.
- Abdulhay M., 2020, 81% of Dubai's share of new green building projects in the world <albayan.ae/economy/local-market/2020-05-07-1.3851675> accessed 22.07.2022. (In Arabic)
- Alfalah G., Zayed T., 2020, A review of sustainable facility management research, *Sustainable Cities and Society*, 55, 102073.
- Alhamlawi F., Alaifan B., Azar E., 2021, A comprehensive assessment of Dubai's green building rating system: Al Sa'fat, *Energy Policy*, 157, 112503.
- Al-Sweifi M., 2018, Property owners: Maintenance and service prices are high, Developers: Owners' associations choose utility management companies, *Emirates Today* <emaratalyoum.com/business/local/2018-10-01-1.1139417> accessed 25.07.2022.
- Arya A., Sharma R.L., 2022, Strategies for green building rating in India: A comparison of LEED and GRIHA criteria, *Materials Today: Proceedings*, 57, 2311–2316.
- Breisinger M., Diez M., Tagwerker C., 2012, Green Buildings Workbook An internal guide for IDB practitioners, Inter-American Development Bank <publications.iadb.org/publications/english/document/Green-Buildings-Workbook-A-Guide-for-IDB-Practitioners.pdf> accessed 25.08.2022.

- Bright A.H., 2019, UAE - Freehold services fees drop in first half < menafn.com/arabic/1098757507/ > accessed 24.08.2022. (In Arabic)
- Elliott L., 2021, (Y)our space discover your new word of work <knightfrank.com/your-space> accessed 22.07.2022.
- Fuller S., 2016 September 19, Life-Cycle Cost Analysis (LCCA) <wbdg.org/resources/life-cycle-cost-analysis-lcca> accessed 11.08.2022.
- Gopanagoni V., Velpula S.L., 2020, An analytical approach on life cycle cost analysis of a green building, *Materials Today: Proceedings*, 33, 387–390
- Green building standards - Official gateway to the UAE government., 2020 < u.ae/ar-ae/information-and-services/environment-and-energy/the-green-economy-initiative/efforts-to-achieve-green-economy-/green-building-codes> accessed 13.08.2022.
- Hajare A., Elwakil E., 2020, Integration of life cycle cost analysis and energy simulation for building energy-efficient strategies assessment, *Sustainable Cities and Society*, 61, 102293.
- Heralova R.S., 2017, Life Cycle Costing as an Important Contribution to Feasibility Study in Construction Projects, *Procedia Engineering*, 196, 565–570.
- Housing Units (Urban and Rural) by Type - Emirate of Dubai (2021)., 2021, Dubai <dsc.gov.ae/Report/DSC_SYB_2021_02_02.pdf> accessed 10.07.2022.
- ISO 15686-5., 2017 < from iso.org/standard/39843.html > accessed 12.06.2022.
- Kambanou M.L., Sakao T., 2020, Using life cycle costing (LCC) to select circular measures: A discussion and practical approach, *Resources, Conservation and Recycling*, 155, 104650.
- Khalid M.S., Ahmad, A.H., Zakaria R., Rozita A., Pon Y., 2017, Towards Strengthening Building Maintenance and Management by Joint Management Bodies (Jmb) in High Rise/Stratified Housing in Malaysia. *International Journal of Social Science and Humanity*, 7(4), 239–242.
- Khan J.S., Zakaria R., Aminuddin E., Abidin N.I., Sahamir S.R., Ahmad R., Abas D.N., 2018, Web-based automation of green building rating index and life cycle cost analysis, 2018, 2nd International Conference on Sustainable Development in Civil, Urban and Transportation Engineering CUTE , 17th- 19th April, Ho Chi Minh, Vietnam, 12062.
- Khan J.S., Zakaria R., Aminudin E., Adiana N.I., Mahyuddin M.A., Ahmad R., 2019, Embedded life cycle costing elements in green building rating tool, *Civil Engineering Journal*, 5(4), 750–758.
- Law No. (6) of 2019 Concerning Ownership of Jointly Owned Real Property in the Emirate of Dubai, 2019, 6, 1–29.
- Moussa R.A., Farag A.A., 2017, The Applicability of LEED of New Construction (LEED-NC) in the Middle East, *Procedia Environmental Sciences*, 37, 572–583.
- O'Brien W., Tahmasebi F., Andersen R.K., Azar E., Barthelmes V., Belafi Z.D., Zhou J., 2020, An international review of occupant-related aspects of building energy codes and standards, *Building and Environment*, 179, 106906.
- Stec A., 2019, *Sustainable Water Management in Buildings: Case Studies From Europe*, Springer Nature, Rzeszów, Poland.
- Wang H., 2018, Life-cycle analysis of repair of concrete pavements. In Hao Wang (Ed.), *Eco-efficient Repair and Rehabilitation of Concrete Infrastructures*, Woodhead Publishing Piscataway, United States, 723–738.
- Weerasinghe A.S., Ramachandra T., Thurairajah N., 2017, Life cycle cost analysis: Green vs conventional buildings in Sri Lanka, 33rd Annual Association of Researchers in Construction Management Conference ARCOM, 4th- 6th September, Cambridge, UK, 309-318.
- Yasinta R.B., Utomo C., Rahmawati, Y., 2020, A Literature Review of Methods in Research on Green Building Cost Analysis, 4th International Conference on Civil Engineering Research ICCER, 22th-23th July, Surabaya, Indonesia.